THERMAL

Wrap

Leader Guide

Style Engineers

Fashion through science

WITH THIS ACTIVITY

- Student Handout

MODULE

We are Engineers! | Movement Improvement | Marvelous Materials | Smart Clothing | Patternmaking Tools n' Tech

Big Picture

Fabrics can be good **insulators** against **conductive** heat loss because fibers and fabrics often trap air, a great insulator, within their structures. Some manufactured fibers have interior spaces filled with air, while fibers, such as wool, have a bulky texture that traps air between fibers in yarns and fabrics. Fabric construction (woven vs. knitted), thickness, weight, density, and surface texture affect the amount of trapped air, and therefore a fabric's effectiveness as an insulator. Layering multiple fabrics can increase the insulative performance of a garment as well by trapping additional air between layers or blocking airflow through open fabrics.

Materials

What they need:

- Student Handout Chart
- Pencils

Supplies to Share:

- 3 yards each of 3 to 5 very different fabrics. These fabrics should reflect fabrics used in ordinary garments, such as t-shirts, woven shirts, denim jeans, polar fleece jackets and ripstop nylon jackets.
- Watch or cell phone timer
- Temperature gun
- Magnifying lenses

Prep Time: 15 Minutes
Activity Time: 30 Minutes
Difficulty: Level 1

What's the goal?

To compare the insulative performance of different fabrics and fabric-layering systems through personal experimentation.

Grouping

Work in pairs

Tips:

- Use fabrics in a variety of fiber types and fabric constructions to provide a range of experiences.
- If you need a refresher in fabric construction, check out Fabric Structures: A Close Look.
- Actual garments could be used for this activity but would need to fit everyone in the group.
- Inexpensive infrared laser temperature guns can be purchased at home improvement centers or online. Look for switches that turn the laser off/on and allow for digital readings in both Centigrade and Fahrenheit.
- ALERT! Caution students NOT to point the laser gun at anyone's eyes.
- Groups may prefer recording data on a large communal chart (poster, newsprint, chalkboard or Smart Board) for easier viewing and discussion.
- The Quick Version makes a great participatory activity at a fair or demonstration. It also complements Alien Incubation and can be completed while waiting for the alien babies to cool.

Preparation

1. Gather together the fabrics, temperature guns and magnifying lenses.
2. Print student handouts, one for each student.
3. Be sure students have pencils to record their findings.

Lets get started!

1. Young designers touch the fabric noting the thickness, weight, and surface textures. Next, they examine the fabric with a magnifying lens to identity the fabric structures (woven or knitted) as well as the density of the construction. They record these observations in the FABRIC DESCRIPTION column of the Student Handout chart.

2. Based on their observations in Step 1, students predict the fabric's performance by ranking the samples from 1 (warmest/best insulator) to 5 (coolest/worst insulator). Record those numbers in the PREDICTION column.

3. Using the temperature gun, read the subject's body temperature at rest (point the device at the back of the neck.) Record that temperature in the BEFORE EXERCISE column.

4. Participants wrap themselves in the fabric they are testing and jump up and down for 20 seconds.

5. Using the temperature gun, read the subject's body temperature (point the device at the back of the neck) while she is still wrapped in the test fabric. Record that temperature in the AFTER EXERCISE column.

6. Repeat Steps 1-5 for the other fabrics.

7. Build and test a layered system.
   Select two of the fabrics to create a layered clothing system. Repeat Steps 1-5 wrapped in the two fabrics.

8. Calculate the change in temperature for each of the samples and write that value in the TEMPERATURE CHANGE column. Use this equation:

After exercise temperature – Before exercise temperature = Temperature change

9. Review the temperature change for each sample and rank its insulative performance from 1 (warmest/largest temperature increase) to 5 (coolest/smallest temperature increase). Record that number in the RESULTS column.

10. Discuss results for individual fabrics and for the layered systems. Compare the prediction rankings of insulative performance to the results rankings.

Quick Version

1. Did the results agree with the predictions?

2. Was there a difference in the insulative performance of fabrics made of different fibers?

3. Which fabric structures held the body heat better, wovens or knits?

4. Did thickness, weight and texture affect the insulative ability of particular fabrics?

5. What changes occurred when two fabrics were used together and how did this compare to those same fabrics used in single layers?

Take it Further

Protective garments often require more than just insulative qualities. If you were to design a ski jacket, for example, what else should you consider? What types of fabrics might be combined to keep a skier comfortable? How about the needs of a firefighter or deep-sea diver?